POSSIBLE SITES FOR BAMBOO PAPER-PULP MILLS IN THE MADRAS PRESIDENCY.

AREA NO. I. (*See portions marked D on map.*)

The Uppinangadi and Puttur bamboo areas in the South Canara Forest Division of the Madras Presidency.

(1) *Name and Situation.*

These forests are situated in the Uppinangadi Taluka of the South Canara Collectorate, some 60 miles inland from Mangalore, and a few miles short of the foot of the Western Ghats. The distance from the centre of the area to the sea is 60 miles. Down the Netravati river to Panimangalore is 40 miles, to which place sailing boats of five tons burden ply daily from Mangalore. The forests are drained in the north and centre by the Netravati river and its tributaries, the Kumardhari and by the Payaswani river in the Puttur Range. (See map.)

(2) *Description of the forests.*

The areas included in this scheme contain moist and dry deciduous forests with patches of evergreen, and are not dissimilar in character to those found in the neighbouring forests of North Kanara in the Bombay Presidency. In places the bamboo growth is not heavy but, in others, especially along small water-courses and in depressions, it is extremely fine and luxuriant.

(3) *Areas of forests covered with bamboos.*

The areas directly taken into consideration in this scheme lie in the Uppinangadi and Puttur Ranges, though mention will hereafter be made of other areas which might also be added and from which raw material could be obtained. The forests now under consideration are made up

of 15 blocks, most of which have no connection one with another, being divided from each other by narrow strips of revenue land.

	Blocks.	Area in acres.	
Uppinangadi Range.	1. Nerinkamale	3,894	
	2. Porkala	4,558	
	3. Shibage	3,456	
	4. Kadambila	1,848	
	5. Konage	6,642	
	6. Padnur	3,900	
			24,298 acres
Puttur Range.	7. Sampaji	5,120	
	8. Pumale	960	
	9. Purappa	1,920	
	10. Kankamajulu	640	
	11. Jalsur W.	960	
	12. Jalsur E.	160	
	13. Anegundi	640	
	14. Kaniarmale	500	
	15. Denachalla	600	
			11,500 acres.
	Total		35,798 acres.

(4) *Species of bamboo and mode of growth.*

By far the greater *portion* of the bamboo forest consists of *Bambusa arundinacea*, which, on the upper slopes of the low hills, is found growing 30 to 40 feet in height, while in the moister and lower areas it grows 70 to 80 feet in height, with a mean mid-girth of 8″. The Working-Plan Officer enumerated 426 acres in the various blocks which go to form the Uppinangadi Range and found 12·8 clumps of bamboo per acre, averaging 10 culms per clump. *Dendrocalamus strictus* bamboo also occurs in the forests, but only in small quantities.

(5) *Possible factory site.*

The most suitable site for a mill would be Panimangalore on the Netravati river (see map). Another possible site would be Mangalore, on the sea, but fuel and labour are more expensive at that port than further up the river. As regards water, a plentiful supply is available throughout the year from the river at Panimangalore.

(6) *Outturn.*

Mr. Foulkes, the Working-Plan Officer, when making the Working-Plan for these forests, enumerated bamboos over 426 acres, by taking sample plots scattered over each block. In these enumerations, he counted all the bamboo clumps in the area, but did not count the number of culms per clump, which has been put at the low estimate of 10 culms per clump. Based on these figures, which should be a very fair guide, the following calculation has been made :—

Name of Range.	Name of block	Area in acres.	Average area of sample plot taken by the Working-Plan Officer, in acres.	Average number of clumps per acre.	Number of bamboos in the whole area, taking 10 culms per clump.
Uppinangadi.	Nerinkemale.	3,894	101·7	12·07	467 280
	Porkala	4,558	121·1	10·92	501,380
	Shibago	3,456	82·6	16·95	584,064
	Kadambila	1,848	35·0	5·74	105,336
	Konago	6,642	86·0	13·35	883,386
	Padnur	3,900	*Nil*	10·0*	390,000
Puttur.	Sampaji	5,120	Do.	12·0	614,400
	Pumalo	960	Do.	10·0	96,000
	Purappa	1,920	Do.	8*	153,600
	Kankamajulu	640	Do.	8*	51,200
	Jalsur W.	960	Do.	8*	76,800
	Jalsur E..	160	Do.	8*	12,800
	Anegundi	640	Do.	6*	38,400
	Kaniarmale	500	Do.	8*	40,000
	Denachalla	600	Do.	8*	48,000
		35,798	426·4	*Estimated	4,062,346

Working on a five-year rotation we arrive at a sustained annual yield of 812,629 bamboos.

Now, from the enumeration of a sample plot in Nerankimale (see Appendix VI), the yield from 140 culms found on one acre was 6, 550 lbs. of dry internodes or, in round figures, 47 lbs. per culm. The annual sustained yield of dry internodes working on a five-year rotation, therefore, works out at 38,193,563 lbs. or 17,051 tons.

It was mentioned elsewhere that other areas might be tapped to supply the factory at Panimangalore with bamboos. Mr. Barry, the Divisional Forest Officer, suggests that bamboos could be floated down the Paishwani river, from the forests it drains, to Kasargad, be railed to Mangalore and taken up the Netravati river to Panimangalore. Were the erection of a mill contemplated at this spot, the possibility of utilizing this source of supply also would have to be duly considered.

(7) *Lines of export.*

A metalled road runs from Mangalore to Manjrabad, passing through the Uppinangadi range and taps the six blocks under consideration, while the Bisli Ghat road runs on the south side of the Padnur block. The average distance over which bamboos would have to be carted to Valol, on the Netravati river, is 15 miles, and the distance over which they will have to be floated from Valol to Panimangalore is 20 miles.

There are two possible ways of exploiting the bamboos from the nine blocks in the Puttur Range. One is by carting them down the Mangalore-Mercara main road and by the Jalsur-Subramania road, an average distance of 40 miles, the other by floating them down the Kumardhari river *via* Uppinangadi to Panimangalore. The river, however, is bad for floating, being full of rapids and boulders. The only way of improving it would be by carrying out fairly extensive blasting operations and by erecting temporary dams, so as to regulate and train the stream. Some three miles above the junction of the Netravati and Kumardhari rivers at Uppinangadi, there is, on the latter river, a low waterfall, which was inspected with a view to ascertain the possibility of utilizing the water-power and finding out if it formed an obstruction to possible floating operations. The river here is very broad, so that extensive works would have to be carried out to utilize the water for power, while it was found that the main channel was sufficiently broad to allow of rafting operations being carried out.

The river from Uppinangadi to Panimangalore is also full of boulders and shallows, though, no real difficulties occur to prevent floating from September to the end of January. After January, the river runs low and rafts containing over 40 bamboos are difficult to manage.

(8) *Cost of cutting and extraction.*

The cost of cutting and exploiting 100 bamboos from the Uppinangadi forests to Panimangalore works out as follows :—

	R.	a.	p.
1. Cost of cutting 100 bamboos	6	0	0
2. ,, ,, dragging to road	2	0	0
3. ,, ,, carting 15 miles to Valol at 2 annas a mile for 3 carts containing 33 bamboos each	5	10	0
4. ,, ,, toll on 3 carts at 4 annas each	0	12	0
5. ,, ,, floating from Valol to Panimangalore	2	0	0
	16	6	0

The cost of exploting 100 bamboos from the Puttur Range works out as follows :—

	a.	p.
1. Cost of cutting 100 bamboos	6	0	0
2. ,, ,, dragging to road	2	0	0
3. ,, ,, carting 40 miles at 2 annas per mile taking 33 bamboos and including toll	15	12	0
	23	12	0

The weight of 100 air-dried bamboos is 5,803 lbs. (see Appendix VI), so that the cost of landing one ton of air-dried bamboos at Panimangalore from the Uppinangadi forest comes to Rs. 6-6 and from the Puttur forests Rs. 9-4 per ton.

(9) *Cost of landing air-dried internodes per ton at factory site.*

From Appendix VI, it will be seen that the dry nodes are, in round figures, 20 per cent. by weight of the entire culms, so that the cost of landing dry internodes from Uppinangadi at Panimangalore works out at Rs. 7-10-6 and from Puttur at Rs. 11-13 per ton. On the other hand, if the nodes are also utilized, these figures must be reduced by 20 per cent. for this locality.

(10) *Labour.*

Cooly labour is fairly plentiful, though some may have to be imported for working in the mill. The wages earned by men are from 4 to 6 annas per day and women $2\frac{1}{2}$ to 3 annas. Good carpenters and masons are available in Mangalore at 12 annas to Re 1 a day. Carts are fairly plentiful but, were bamboos to be carted in large quantities from the Puttur forests, more carts would have to be introduced.

(11) *Firewood.*

Firewood is very plentiful in these forests, and the demand comparatively small. Its price is from Rs. 3 to Rs. 4 per ton at Uppinangadi and Rs. 6 per ton at Panimangalore.

(12) *Chemicals.*

Shell-lime is available in large quantities on the coast: it is sold in bags of 160 lbs. each, and the price of 100 such bags is Rs. 28.

The Bombay Steam Navigation Company's steamers call at the port of Mangalore, so that the cost of importing the necessary supplies, chemicals and fuel by sea should not be excessive. The terminus of the Madras Railway is situated at Mangalore, by which chemicals could be imported when steamer traffic is stopped during the monsoon.

(13) *Miscellaneous facts.*

The site chosen for the factory at Panimangalore is, generally speaking, a healthy one, the country being open and flat. The forests from which the bamboos can be exploited are feverish just after the rains. The coast rivers are, generally speaking, more silted up in this district than is the case in North Kanara, which is probably due to the excessive denudation of all tree-growth on the waste lands. For this reason, the streams are shallower, rendering navigation more difficult, and at the same time, rendering the rivers more liable to excessive floods in the monsoon.

AREA NO. II. (*See portion marked* ***E*** *on map.*)

The Kanoth bamboo forests of the North Malabar Forest Division of the Madras Presidency.

(1) *Name and Situation.*

These forests are situated in the Kottayam Taluka of the Malabar Collectorate, some 20 miles inland from the seaport of Tellicherry and directly below the Wynaad forests of the Western Ghats. To the south of the bamboo area runs a small stream, known as the Edayer, the northern limit being the Tellicherry-Manantoddy high road.

(2) *Description of the forests.*

The area covered with bamboos is extremely limited, so that, were a mill to be erected and supplied from this area, it would necessarily have to be run on a small scale. The forests containing the bamboos lie in the valley of the Edayer (see map) and though forests extend up the range of hills to the south, and also cover the Western Ghats to the east, they contain but few bamboos. On the more level ground, to the south of the main road and extending up the valley to Nedumboil Chuttram, the bamboo growth is in many places extremely fine, and some of the culms exceed in size and weight any stems of this species weighed elsewere.

(3) *Area of forest covered with bamboos.*

The total area of the block is 19,018 acres ; of this, the forests lying in the valley cover some 3,000 acres and are densely stocked with bamboos. The rest of the area contains semi-moist-deciduous forest, in which bamboos occur, but only scattered here and there in small quantities.

(4) *Species of bamboos and mode of growth.*

The prevailing species is *Bambusa arundinacea* and therefore the same as that prevailing throughout the entire length of the Western Ghats. It forms in these forests very fine clumps, containing many large culms. The average length of 200 cut stems was 56½ feet and 10·7″ mid-girth, representing a length of about 10 feet and a girth of 2″ in excess of any

previously recorded. The other species found in these forests is *Dendrocalamus strictus*, a small strong bamboo, the demand for which in the market is already equal to, if not greater than, the possible outturn, so that from the point of view of pulp-making it may be neglected. There exists to the south of the main road, and some three miles from the Travellers' Bungalow, a bamboo plantation in which several exotics, chiefly from Burma, have been introduced and which have done remarkably well. The area of the plantation is, however, of insufficient size, to be of any real importance, except to demonstrate the possibility of cultivating such species in this locality.

(5) *Possible factory site.*

It is not easy to fix on a suitable site for a factory. The best place would probably be above the village of Kuttaparamba, in the Edayer creek, at a point a little above that at which the tide makes itself felt. To ensure a sufficient supply of fresh water for the mill, it would be necessary either to dam the river or prepare storage tanks, otherwise there would be insufficient water from February onwards till the monsoon sets in. The distance of the proposed site is 12 miles from the centre of the bamboo area and 8 from the Railway station of Tellicherry, both places being on the Tellicherry-Manantoddy high road, which also passes through the bamboo area. The proposed site is by no means an ideal one, though the best which could be found.

(6) *Outturn.*

The area from which bamboos can be exploited is small, though this defect is in a measure compensated for by the heavy crop. From Appendix VI, it will be seen that the average outturn of dry internodes is 29,909 lbs. per acre or 13·3 tons, which gives a gross yield of 39,900 tons, or by cutting on a five-year rotation a sustained yield of 7,980 tons of dry internodes per annum. In the above calculation, only the area which is densely covered with bamboos has been taken into account, so that the figure of sustained yield, which might be augmented by fellings in the other portions of the block, may be taken as a low estimate.

(7) *Lines of export.*

A small river, named the Edayer, which is about 20 yards broad at Kanoth, runs down the south boundary of the bamboo area. Along the

north side, running the whole length of the area, is the Tellicherry-Manantoddy metalled road. Along this road, the gradients, within and below the bamboo area, are nowhere steep, so that loaded carts can be moved along it without difficulty. The stream is not really suitable for floating bamboos, though it could be utilized for the purpose during the months of August, September and October. The Southern India Railway runs through Tellicherry, northwards along the coast to Mangalore and southwards to Calicut.

(8) *Cost of cutting and extraction.*

It has been mentioned above that bamboos will have to be transported from the forest to the mill by carts. They will also have to be dragged from the forest to the road, a distance which will rarely exceed a mile. Under these conditions the cost of landing air-dried bamboos, from the centre of the area to Kuttaparamba, works out as follows :—

	R.	*a.*	*p.*
1. Cost of cutting 100 bamboos	6	0	0
2. ,, ,, carting at 4 annas per mile, over 12 miles, and 20 bamboos per cart	15	0	0
3. ,, ,, dragging to road	2	0	0
Total .	23	0	0

The reason why the estimated number of bamboos per cart has been put as low as 20 is that the average dry bamboo with nodes weighs as much as 63 lbs. so that 20 weigh about $\frac{1}{2}$ ton which is the capacity of cart over a good road.

(9) *Cost of landing air-dried internodes per ton at the factory site.*

From Appendix VI it will be seen that the dry nodes make up 16 per cent. of the total weight of a dry bamboo. Now the average weight of 100 air-dried bamboos is 6,370 lbs. or 63·7 lbs. per bamboo, of which 10·2 lbs. is the weight of the nodes. It, therefore, takes 42 bamboos to make up one ton of dry internodes. It costs Rs. 23 to land 100 such bamboos at the mill, so that one ton of dry internodes will cost Rs. 9-10-6 per ton at Kuttaparamba.

(10) *Labour.*

Cooly labour is not available in large quantities, and will certainly have to be imported from the coast villages. The usual wages for men is 4 to 6 annas per day, according to the season. Skilled labour, such as carpenters and masons, is available from Tellicherry, failing which it could be procured from Mangalore or Calicut. The supply of carts is also insufficient and will have to be augmented by supplies from other parts.

(11) *Firewood.*

Firewood is available in considerable quantities from the neghbouring forests and possibly from the Ghat forests above the bamboo area, though the labour to collect it and the carts with which to transport it to the mill will not be sufficient unless more are introduced into the district. Coal is available on the railway, though its price is high, the area being far from the coal-fields. The question of fuel is therefore one which will require careful attention.

(12) *Chemicals.*

Shell-lime is procurable on the coast at about 12 annas per cwt. The other chemicals can be imported cheaply by sea or failing that line of supply in the monsoon, they can be railed to Tellicherry and carted to the mill, a distance of 8 miles.

(13) *Miscellaneous facts.*

The site selected for the factory is not unhealthy. The difficulty does not appear to lie in this direction but in the labour question, the cost of fuel and possibly the water-supply, all of which points will require careful consideration before coming to any decision as to the advisability of erecting a pulp-mill in this locality.

AREA NO. III. (*See portions marked* ***F*** *on the map.*)

The Nilambur and Amarampalam Bamboo areas of the South Malabar Forest Division of the Madras Presidency.

(1) *Name and Situation.*

These forests are situated in the Nilambur and Amarampalam Ranges of the South Malabar Division, in the open valley formed by the Chaliar

river and its tributaries, some 50 miles from the sea and stretching 8 to 9 miles above the village of Nilambur. The river Chaliar finds its way from the slope of the Nilgiris, passing in its upper reaches through the bamboo and teak forests above mentioned, to the sea at Calicut.

(2) *Description of the forests.*

The forest areas lie on the slightly undulating ground to the north of the Chaliar river (see map) and comprise moist-deciduous forest, in which extensive clearings have been made and on which has been created the famous Nilambur teak plantation. The growth of bamboos, where such clearings have not been carried out, is generally dense, the culms being often of enormous size. To the south of the river lie private forests, also well stocked with bamboos.

(3) *Area of forest covered with bamboos.*

In computing the area covered with bamboos, those covered with plantations have not been taken into account. Though no enumeration was made in the Private Forests to the south of the river, they may also be taken into account in this scheme, as it is understood that they would also be available for the supply of bamboos.

The following figures of areas have been taken from the Working-Plan prepared for these forests :—

	Name of Block.	Area.
Nilambur Range	Vellachapally	623 acres.
	Pokode	508 ,,
	Kanakutha	668 ,,
	Chattawbaria	215 ,,
	Valluvasheri	204 ,,
	Panayangote	..
	Eranbaden	282 ,,
	Eddakode	580 ,,
		—— 3,080 acres.
Amarampalam Range	Kallikutta	..
	New Amarampalam	2,500 acres.
	Private Forests	3,800 ,,
		—— 6,300 acres.
	GRAND TOTAL	9,380 acres.

(4) *Species of bamboos and mode of growth.*

The species is the same as elsewhere on the West Coast, being *Bambusa arundinacea*, the culms of which are large and many of which go to form a clump. In the first seven blocks mentioned in the above list, the bamboo growth is dense, while the forests of the Amarampalam Range and the Private Forests to the south of the river, are fairly well stocked with bamboos. The palisade of thorny branches, of which mention has been made elsewhere, is even heavier round the clumps in these forests than is the case in the forests of North Malabar and in Kanara.

(5) *Possible factory site.*

The most suitable factory site is probably near the village of Chaliapuram, situated on the Chaliar river, 24 miles from the sea, and above tidal level. The longest line, along which floating from the reserves would have to be carried out, is 26 miles. Chaliapuram has the advantage of being so situated that five-ton sailing boats can reach it from Calicut at all times of the year, that the bamboos can be floated down without difficulty to the mill from the forest, and that there is a plentiful supply of fresh water available. Were the mill to be erected at Calicut, which is more central and on the railway and also a seaport there might be difficulty in obtaining a sufficient supply of fresh water. It is true that the cost of importing the chemicals might be reduced by placing the mill at the seaport of Calicut, but, on the other hand, the cost of transporting them to Chaliapuram in sailing boats would be relatively small.

(6) *Outturn.*

The possible outturn is based on the enumerations made in these forests (see Appendix VI). Owing to the limited time available, only two sample plots were taken, so that, for the forests in the Amarampalam Range and in the Private Forests, which were inspected and found to contain rather less bamboos than in the forests where enumerations were made, a 20 per cent. reduction has been adopted. The average outturn of dry internodes is 25,544 lbs. or 11·4 tons per acre. The area of the fully-stocked bamboo forest is 3,080 acres and that of fairly-stocked forest, to be calculated on a 20 per cent. reduction or at 9·1 tons per acre. is 6,300 acres. The gross yield of dry internodes, therefore, works out for

both areas together, at 92,442 tons. Cutting on a five-year rotation, the sustained supply of air-dried internodes comes to 18,488 tons per annum. These figures, as elsewhere explained, may be raised by 16 per cent. if the nodes are taken into account.

(7) *Lines of export.*

Bamboos can be floated down the main stream of the Chaliar river throughout the year, and down its tributaries from July to November. The longest distance over which floating will have to be carried out from the forests of Nilambur and the Private Forests, to a mill at Chaliapuram, is 26 miles.

From the forests of the Amarampalam Range, the bamboos will have to be floated down the Karimpoya river and its tributaries, the former being a large tributary of the Chaliar river, the junction of the two streams occurring just above the village of Nilambur. Floating is possible down one tributary of the Karimpoya from as far up as the village of Nedamgam and also from up another tributary of the same river to Nellinkutta, so that the extreme distance, over which bamboos would have to be dragged or carted from the forests of Amarampalam to a floating stream, would be 4 to 5 miles. From that point, they can be floated down to the proposed mill site without difficulty.

The Chaliar river is also available as a means of communication with Calicut as sailing boats come up to Chaliapuram throughout the year. Calicut is also a seaport and at Kalai, 3 miles from Calicut, exists a station of the South Indian Railway, close to a navigable branch of the river.

(8) *Cost of cutting and extraction.*

The cost of felling and extraction from the Nilambur and Private Forests works out as follows :—

	R.	*a.*	*p.*
1. Cost of cutting 100 bamboos	6	0	0
2 ,, ,, dragging to floating stream, an average distance of one mile	2	0	0
3. ,, ,, floating to factory site	2	0	0
	10	0	0

Cost of extraction from the forests of the Amarampalam Range:—

	R	a.	p.
1. Cost of cutting 100 bamboos	6	0	0
2. ,, ,, carting or dragging 5 miles to a floating stream, a cart taking 20 bamboos, at 4 annas per mile	6	4	0
3. ,, ,, floating 30 miles to mill	2	12	0
	15	0	0

(9) *Cost of landing air-dried internodes per ton at the factory site.*

From Appendix VI, it will be seen that the dry nodes make up, in round figures, 14 per cent. of the dry culms. To this figure 2 per cent. should be added for loss in sawing, or a total of 16 per cent. should be deducted from the total weight of the bamboos in order to arrive at the weight of the dry internodes. From the same statement it will be seen that a dry culm weighs 72 lbs. or after deducting the weight of the nodes 60·5 lbs. It therefore requires 37 culms to produce a ton of air-dried internodes. The cost of landing one ton of dry internodes at the mill site, therefore, works out to Rs. 3-11-2 per ton from the Nilambur and Private Forests and Rs. 5-8-10 per ton from the forests of the Amarampalam Range. Provided the nodes are also treated, the cost of extraction would be reduced by 16 per cent.

(10) *Labour.*

Cooly labour is fairly plentiful along the coast and could be imported at 6 annas per day. Carts cost 4 annas per mile and will carry up to 6 cwts. Masons and carpenters are available in Calicut at about Re. 1 per day. The same labour difficulties, which were anticipated in the case of Kanoth, should not occur in Nilambur.

(11) *Firewood.*

Firewood is fairly plentiful at Nilambur and, it is estimated, would cost Rs. 4 to Rs. 5 per ton at Chaliapuram, exclusive of royalty. The yield is roughly estimated at 2,000 tons per annum.

(12) *Chemicals.*

Shell-lime is available in fairly large quantities along the coast, and costs about Rs. 13 per ton or Rs 14 per ton at the mill. The other

chemicals necessary would have to be imported by sea, their prices at Calicut and Bombay being approximately the same, if imported from Europe.

(13) *Miscellaneous facts.*

The place proposed for the mill is a healthy spot as compared with many similar localities on the West Coast. Nilambur has also not a bad reputation, it being the head-quarters of the Divisional Forest Officer of South Malabar. The proposed mill site presents several advantages over the other places, which have been dealt with in Madras, in that, it lies on a large river, so that not only can bamboos be floated down during the greater part of the year, but also it is in direct communication by sea and railwith the outside world.